Claims

What is claimed is:

1. A method for dynamically establishing an ad-hoc network including a plurality of work machines , one or more of which may move within a work environment and each of which includes a gateway, the method performed by a respective gateway included within a respective one of the work machines comprising:

determining a first set of work machines that are within direct communication range of the respective work machine based on the work machine's current location within the work environment;

determining a second set of work machines that are in direct communication range of one or more of the work machines in the first set;

forwarding a packet received from a first work machine included in the first set to a second work machine included in the first set based on a determination that the second work machine is either directly or indirectly within communication range of a third work machine included the second set; and

updating the work machines included in at least one of the first and second set of work machines based on at least one of (i) the respective work machine changing locations within the work environment and (ii) any of the work machines included in the first or second sets changing locations within the work environment.

2. The method of claim 1, wherein the packet is destined to a destination work machine not included in the first or second set of work machine, and forwarding the packet includes:

forwarding the packet to the second work machine based on a determination that the third work machine is in direct communication range of the destination work machine.

3. The method of claim 1, wherein the packet is destined to a destination work machine not included in the first or second set of work machine, and forwarding the packet includes:

forwarding the packet to the second work machine based on a determination that the third work machine can indirectly communicate with the destination work machine.

4. The method of claim 1, wherein determining the first set of work machines includes:

broadcasting an admission packet;

receiving a response from at least one of the first and second work machines; and

adding at least one of the first and second remote work machines to the first set of work machines based on the received response.

5. The method of claim 4, wherein determining a second set of work machines includes:

collecting, from the response, an identifier associated with the third work machine; and

adding the third work machine to the second set of work machines, wherein the identifier reflects that at least one of the first and second work machines are either directly or indirectly in communication with the third work machine.

6. The method of claim 1, wherein updating the work machines included in the at least one of the first and second set of work machines further includes:

determining that the respective work machine has moved to a first location; and

repeating the determining of the first set of work machines when the first location is beyond a certain distance from the current location.

7. The method of claim 1, wherein updating the work machines included in the at least one of the first and second set of work machines further includes:

periodically repeating the step of determining the first set of work machines.

8. The method of claim 1, wherein updating the work machines included in the at least one of the first and second set of work machines further includes:

removing from the first set any work machines that are not in direct communication with the respective work machine.

9. The method of claim 8, wherein updating the work machines included in the at least one of the first and second set of work machines further includes:

removing from the second set any work machines that are not in direct communications with any work machines included in the first set.

10. The method of claim 1, wherein the respective work machine is connected to at least two data links capable of transmitting the packet from the respective work machine and forwarding the packet further includes:

selecting one of the at least two data links to forward the packet to the first work machine based on at least one of an availability status of each of the data links, the cost of communicating over each data link, a quality of service associated with each data link, a priority of the packet, and a transmission time associated with each data link.

11. The method of claim 1, wherein the packet is destined to a destination work machine and the respective gateway includes a first network table, and forwarding the packet includes:

forwarding the packet to the second work machine based on a determination that the second work machine is associated with the destination work machine in the first network table.

12. The method of claim 1, wherein the packet is destined to a destination work machine and the respective gateway includes a first and second network table, and forwarding the packet includes:

forwarding the packet to the second work machine based on a determination that the destination work machine is associated with the third work machine in the second network table and the third work machine is associated with the second work machine in the first network table.

13. A system for dynamically establishing communications between work machines, one or more of which may move within a work environment, the system comprising:

a first work machine positioned in a first location within the work environment;

a first gateway included in the first work machine that connects an on-board data link with an off-board data link; and

a network table included in the first gateway that identifies work machines that are either directly or indirectly within communication range of the first work machine, wherein the network table identifies a first set of work machines that are within communication range of the first work machine and identifies a second set of work machines that are within communication range of any of the work machines in the first set,

wherein the first gateway is configured to:

update the network table based on at least one of (i) the first work machine changing locations within the work environment and (ii) any of the work machines included in the first or second sets changing locations within the work environment,

receive a packet over the off-board data link from a second work machine included in the first set, wherein the packet identifies a destination work machine,

forward the received packet to a third work machine included in the first set based on a determination that the destination work machine is associated with the third work machine in the network table, and

send information included in the received packet to the on-board data link when the packet identifies the first work machine as the destination work machine.

14. The system of claim 13, wherein the first gateway is configured to update the work machines included in the at least one of the first and second set of work machines identified in the network table based on at least one of (i) the first work machine moving out of communication range of any work machine in the first set, (ii) any one of the work machines included in the first set moving out of communication range of the first work machine, (iii) any one of the work machines in the first set moving out of communication range of any one of the work machines in the second set, and (iv) any of the work machines in the second set moving out of communication range of any one of the work machines in the first set.

15. The system of claim 13, wherein the network table includes a first level table identifying the first and second set of work machines and a second level table identifying a third set of work machines that are within communication range of any of the work machines in the second set, and wherein the first gateway is further configured to:

forward the packet to the third work machine based on a determination that the destination work machine is associated with a fourth work machine included in the third set and the third work machine is associated with the fourth work machine in the second level table.

16. The system of claim 13, wherein the first gateway is further configured to:

broadcast an admission packet;

receive a response from at least one of the second and third work machines; and

add at least one of the second and third remote work machines to the first set of work machines based on the received response.

17. The system of claim 13, wherein the first gateway is further configured to:

periodically broadcast an admission packet to determine whether the first work machine is within communication range of any of the work machines in the work environment.

18. The system of claim 17, wherein the first gateway is further configured to:

remove a work machine from the first set when the first work machine can no longer directly communicate with that work machine.

19. The system of claim 17, wherein the first gateway is further configured to:

remove a work machine from the second set when the work machine can no longer directly or indirectly communicate with the destination work machine.

20. The system of claim 13, wherein the first work machine is connected to at least two data links capable of transmitting the packet from the first work machine and the first gateway is further configured to:

select one of the at least two data links to forward the packet to the third work machine based on at least one of an availability status of each of the data links, the cost of communicating over each data link, a quality of service associated with each data link, a priority of the packet, and a transmission time associated with each data link.

21. The system of claim 13, wherein the first gateway is further configured to:

translate the information included in the received packet to a format compatible with the on-board data link when the packet identifies the first work machine as the destination work machine.

22. The system of claim 13, wherein the third work machine includes a respective gateway that is configured to check a respective network table to identify a fourth work machine that is either directly or indirectly in communication with the destination work machine and forward the packet received from the first work machine to the fourth work machine.

23. The system of claim 13, wherein the first gateway is configured to:

trace the network table to determine the association between the third work machine and the destination work machine.

24. The system of claim 23, wherein the association between the third work machine and destination work machine includes an intermediate work machine that is in direct communication with the third and destination work machines.

25. A gateway included in a first work machine located in a work environment comprising one or more other work machines, each work machine capable of moving within the work environment, the gateway comprising:

a first interface connected to an on-board data link interconnecting one or more on-board modules; and

a second interface connected to one or more off-board data links each capable of being communicatively connected to any of the other machines,

wherein the gateway includes:

means for sending an admission packet over one of the off-board data links, the admission packet including a first identifier associated with the first work machine,

means for determining whether a response to the admission packet is received,

means for updating a network table based on the determination, wherein the network table includes a second identifier associated with a second work machine that is in communication range of the first work machine and a third identifier associated with a third work machine that is in communication range of the second work machine, and

means for forwarding a packet received from the second work machine to the third work machine based on a determination that the third network work machine is identified in the network table.

26. A computer-readable medium including instructions for performing, when executed by a processor, a method for dynamically establishing an ad-hoc network including a plurality of work machines, one or more of which move within a work environment and each of which includes a gateway, the method performed by a respective gateway included within a respective one of the work machines comprising:

determining a first set of work machines that are within direct communication range of the respective work machine based on the respective work machine's current location within the work environment;

determining a second set of work machines that are in direct communication range of one or more of the work machines in the first set;

forwarding a packet received from a first work machine included in the first set to a second work machine included in the first set based on a determination that the second work machine is either directly or indirectly within communication range of a third work machine included the second set; and

updating the work machines included in at least one of the first and second set of work machines based on at least one of (i) the respective work machine changing locations within the work environment and (ii) any of the work machines included in the first or second sets changing locations within the work environment.

27. The computer-readable medium of claim 26, wherein the packet is destined to a destination work machine not included in the first or second set of work machine, and forwarding the packet includes:

forwarding the packet to the second work machine based on a determination that the third work machine is in direct communication range of the destination work machine.

28. The computer-readable medium of claim 26, wherein the packet is destined to a destination work machine not included in the first or second set of work machine, and forwarding the packet includes:

forwarding the packet to the second work machine based on a determination that the third work machine can indirectly communicate with the destination work machine.

29. The computer-readable medium of claim 26, wherein determining the first set of work machines includes:

broadcasting an admission packet;

receiving a response from at least one of the first and second work machines; and

adding at least one of the first and second remote work machines to the first set of work machines based on the received response.

30. The computer-readable medium of claim 29, wherein determining a second set of work machines includes:

collecting, from the response, an identifier associated with the third work machine; and

adding the third work machine to the second set of work machines, wherein the identifier reflects that at least one of the first and second work machines are either directly or indirectly in communication with the third work machine.

31. The computer-readable medium of claim 26, wherein updating the work machines included in the at least one of the first and second set of work machines further includes:

determining that the respective work machine has moved to a first location; and

repeating the determining of the first set of work machines when the first location is beyond a certain distance from the respective work machine's current location.

32. The computer-readable medium of claim 26, wherein updating the work machines included in the at least one of the first and second set of work machines further includes:

periodically repeating the step of determining the first set of work machines.

33. The computer-readable medium of claim 26, wherein updating the work machines included in the at least one of the first and second set of work machines further includes:

removing from the first set any work machines that are not in direct communication with the respective work machine.

34. The computer-readable medium of claim 33, wherein updating the work machines included in the at least one of the first and second set of work machines further includes:

removing from the second set any work machines that are not in direct communications with any work machines included in the first set.

35. The computer-readable medium of claim 26, wherein the respective work machine is connected to at least two data links capable of transmitting the packet from the respective work machine and forwarding the packet further includes:

selecting one of the at least two data links to forward the packet to the first work machine based on at least one of an availability status of each of the data links, the cost of communicating over each data link, a quality of service associated with each data link, a priority of the packet, and a transmission time associated with each data link.

36. The computer-readable medium of claim 26, wherein the packet is destined to a destination work machine and the respective gateway includes a first network table, and forwarding the packet includes:

forwarding the packet to the second work machine based on a determination that the second work machine is associated with the destination work machine in the first network table.

37. The computer-readable medium of claim 26, wherein the packet is destined to a destination work machine and the respective gateway includes a first and second network table, and forwarding the packet includes:

forwarding the packet to the second work machine based on a determination that the destination work machine is associated with the third work machine in the second network table and the third work machine is associated with the second work machine in the first network table.

38. A method for dynamically establishing an ad-hoc network including a plurality of work machines , one or more of which may move within a work environment and each of which includes a gateway, the method performed by a respective gateway included within a respective one of the work machines comprising:

determining a first set of work machines that are within direct communication range of the respective work machine based on the work machine's current location within the work environment;

determining a second set of work machines that are in direct communication range of one or more of the work machines in the first set; and

forwarding a packet to a second work machine included in the first set based on a determination that the second work machine is either directly or indirectly within communication range of a third work machine included the second set, wherein the packet is either (i) received from a first work machine included in the first set or (ii) generated within the respective work machine,

wherein determining a first set, determining a second set, and forwarding are performed when the respective work machine is prepared to forward the packet to another work machine.